Relational Responding and Conditional Discrimination Procedures: An Apparent Inconsistency and Clarification

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This article discusses theoretical issues relating to an apparent terminological inconsistency between two recent studies involving relational responding. These studies employed a functionally similar protocol to establish contextual cues for arbitrarily applicable relational responding by using a nonarbitrary relational responding procedure; however, one employed the term *nonarbitrary* regarding this procedure, and the other used *arbitrary*. Both can be legitimately described as correct, but they use apparently contradictory descriptions because they focus on different aspects of the protocol; in one, the label is based on traditional conditional discrimination task nomenclature, whereas in the other, it is based on the type of relational responding being performed. The current article describes and then explains the issue. In doing so, it touches on an important topic concerning the relation between relational responding and the conditional discrimination procedure.

Key words: relational responding, relational frames, conditional discrimination, matching to sample

Berens and Hayes (2007) used a training procedure referred to as *nonarbitrary training*, in which a child is required to choose either a smaller or a greater number of coins in the presence of the auditory stimuli "Which pile of pennies has less?" and "Which pile of pennies has more?," respectively. Dougher, Hamilton, Fink, and Harrington (2007) used a functionally similar procedure in which the participants are required to choose the small, the medium or the large from an array of three stimuli in the presence of particular abstract stimuli. The authors refer to this procedure as *arbitrary match to sample*.

Figure 1 displays an illustration of a typical "more than" training trial as used in each of the two procedures. As can be seen, in both cases, the setup constitutes a typical conditional discrimination configuration that involves a conditional stimulus and two or more potential discriminative stimuli. The aim of these types of procedures is to train the subject to choose the experimenter-designated discriminative stimulus in the presence of each of the appropriate conditional stimuli. In fact, as will be explained, the purpose of both procedures is to establish contextual cues for generalized relational responding by employing nonarbitrary relational responding (NARR). However, in one case the training is characterized as arbitrary and in the other it is characterized as nonarbitrary. Thus, there appears to be a contradiction or inconsistency between these two articles with respect to this procedure.

In the present article we argue that in fact both descriptions could be legitimately described as correct, but they use apparently contradictory descriptions because they are focused on different aspects of the protocol; in one case, the label used is based on traditional conditional discrimination

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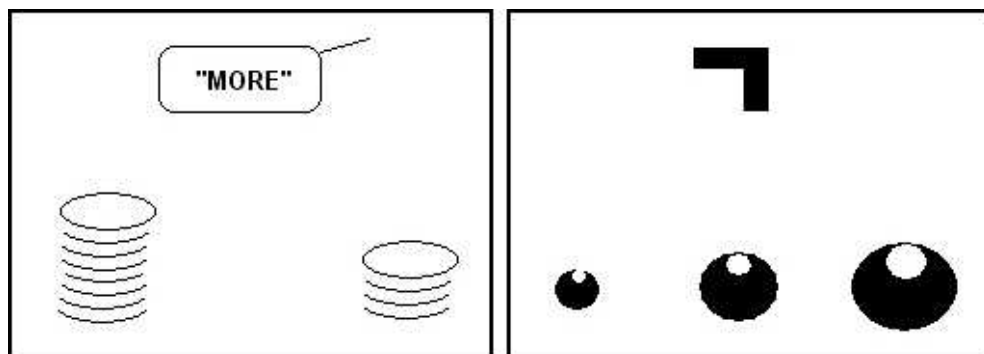
Figure 1.   Illustrations of typical more than training trials as used by Berens and Hayes (2007) (left) and Dougher et al. (2007) (right).

task nomenclature, whereas in the other, it is based on the type of relational responding being performed. In this article we will first lay out the background to this issue and then clearly explain the issue itself, and as we do so, we will touch on an important topic concerning the relation between relational responding and the conditional discrimination procedure itself. We will start by discussing relational responding as examined using the conditional discrimination procedure.

Conditional discrimination

According to Saunders and Williams (1998), "in a conditional discrimination, the function of a discriminative stimulus (whether it is S+ or S–) changes based on the presence of another stimulus—the conditional stimulus" (pp. 210–211). In both cases we are considering in this paper, there is a conditional discrimination procedure being employed. In both studies, there is a training phase in which each trial involves one of a number of conditional discriminative stimuli being presented initially, with a number of potential discriminative stimuli appearing subsequently. On each trial, the subject must choose the appropriate (S+) stimulus in order to be successful on that trial.

For example, in Berens and Hayes (2007), each child had to choose either a smaller or a greater number of coins in the presence of the auditory stimuli "Which pile of pennies has less?" and "Which pile of pennies has more?," respectively. In Dougher et al. (2007), a functionally similar procedure was employed in which the participants were required to choose the small, the medium, or the large from an array of three stimuli in the presence of particular abstract stimuli. In both cases the conditional discrimination performance was being used as a measure of relational responding. To advance our discussion, therefore, we turn next to the definition of relational responding.

Relational Responding

In relational responding, a subject is not simply responding to a single stimulus as determined by context but is in fact responding to one stimulus in terms of another stimulus (e.g., Hayes, Fox, et al., 2001). This latter definition of relational responding has been used a number of times in the behavioral literature, and it does seem to capture certain important features of this phenomenon. Furthermore, according to this definition, any and every conditional discrimination is an example of relational responding in which a discriminative stimulus is related to a conditional discriminative stimulus. For example, if we train an animal to choose a horizontal line in the

presence of the color green and a vertical line in the presence of the color red, then we are effectively training two examples of what has been referred to sometimes as unidirectional relational responding (i.e., horizontal → green, vertical → red).

In this paper, however, we argue that relational responding involves more than simply responding to one specific stimulus in terms of another specific stimulus. According to this definition, relational responding should be able to be generalized so that it involves responding in accordance with some type of pattern rather than on the basis of one or a limited number of associations. If this stricter definition is to be accepted, then a specific trained conditional discriminative performance is not a relational performance; thus, the example given in the previous paragraph would be ruled out as an example of relational responding. One very important form of behavior that would still be included however is identity matching.

Identity matching is an example of relational responding that has been examined using the conditional discrimination protocol. In a typical identity matching setup, the conditional stimulus is presented first and the potential discriminative stimuli are presented subsequently; the correct discriminative stimulus on that trial is the one that is physically (along some experimenter-designated dimension) identical to the conditional stimulus. For example, the conditional discrimination stimuli in a computer-presented identity matching task might be a red circle and a green circle and the potential discriminative stimuli might be a red circle and a green circle. On a trial in which the red circle appears as the conditional discrimination stimulus, the correct (bottom screen, discriminative) stimulus is the red circle. On a trial in which the green circle appears as the conditional discrimination stimulus, the correct (bottom screen, discriminative) stimulus is the green circle. For true identity matching to be displayed, the subject must show generalization of this performance to novel sets of stimuli such that he or she consistently chooses on the basis of a relation of nonarbitrary or formal (in this case, color) similarity between the conditional discrimination stimulus and the discriminative stimulus.

The identity matching conditional discrimination task is the prototypical example of what is referred to as a matching-to-sample (MTS) task (see, e.g., Cummings & Berryman, 1961). When describing MTS tasks, the convention is to refer to the stimulus presented initially as the sample stimulus (hence the name matching to sample), and the stimuli presented subsequently, from which the subject has to choose, as the comparison stimuli. Even though, strictly speaking, it is not always the case in every type of conditional discrimination task involving an initial stimulus and several subsequent stimuli from which a choice must be made that the subject is matching to the sample when he or she chooses a comparison (e.g., in oddity tasks the subject is required to choose the subsequently presented stimulus that does not resemble the initial stimulus), such tasks are often referred to as MTS tasks, and the stimuli involved in the task are referred to as sample and comparison stimuli, respectively. For ease of communication, we will adopt this usage in the remainder of this paper.

Identity matching is an example of nonarbitrary (or formal) relational responding because the subject is choosing based on a relation between nonarbitrary or formal properties of the stimuli being related. Such properties (e.g., color, shape, quantity, size) are referred to as *nonarbitrary* because they are not subject to social whim, as contrasted with arbitrary or arbitrarily applicable properties (e.g., "aesthetic value" or "goodness"). In the case of identity matching, the

relation is one of sameness or similarity, but there are many other types of nonarbitrary relational responding as well. Another example is nonarbitrary relational responding in accordance with comparison. In this case, the subject might be required to consistently choose a comparison stimulus that is either bigger or smaller than the sample stimulus. Once again, a core criterion for whether the subject is showing true nonarbitrary relational responding is generalization of the response pattern to novel stimuli. For example, if a subject has been trained to always choose the comparison that is bigger than the sample, then a true test of nonarbitrary comparison relational responding might be exposure to a conditional discrimination involving previously unseen stimuli in which the only comparison bigger than the sample must be chosen.

NARR is a specific form of responding that can be examined using the conditional discrimination procedure. According to relational frame theory (RFT; see, e.g., Hayes, Barnes-Holmes, & Roche, 2001), another specific form of responding that can be examined using this procedure is arbitrarily applicable relational responding (AARR). This is a type of relational responding based not on any nonarbitrary or formal relations between the stimuli being related but on aspects of the context that specify the relation such that the relational response can be brought to bear on any relata regardless of their nonarbitrary properties.

As an example of AARR, imagine I teach a verbally able child that "John is faster than Mary and Mary is faster than Ann" and imagine that the child is then able to derive multiple new relations including, for example, "John is faster than Ann" and "Ann is slower than John." From a technical perspective, I am presenting the child with a contextual cue (i.e., "faster") that has been previously established in the child's learning history as controlling a particular relational response pattern; as a result of the presentation of that cue, that response pattern is being brought to bear on an arbitrarily chosen set of names.

RFT suggests that AARR is the ability that underlies human verbal behavior and that facilitates the flexibility, generativity, and rapid acquisition that characterize normal language development. From this perspective, AARR first begins to develop with the establishment of word–object bidirectional relational responding (see, e.g., Hayes, Fox, et al., 2001, pp. 26–27, for a description of the processes suggested to be involved in this early learning). The word–object relation thus established can be seen as a preliminary version of an AARR pattern of sameness, in which the child is taught to treat a word and an object as functionally similar under the control of the word *is* and other contextual cues for this pattern. Furthermore, RFT argues that on the basis of continuing exposure to socioverbal interactions, the child will learn to respond in accordance with patterns of sameness that involve more than two stimuli (e.g., stimulus equivalence) and will also learn to respond in accordance with patterns of contextually controlled AARR other than sameness, such as comparison, difference, opposition, and so on.

RFT maintains also that in many cases of AARR, formally based NARR is a precursor and foundation for the abstracted arbitrarily applicable pattern. For example, before graduating to fully abstract arbitrarily applicable comparative relational responding, a child will likely first learn to choose the physically larger of two objects in the presence of auditory stimuli such as "bigger" and to choose the physically smaller of two objects in the presence of stimuli such as "smaller." RFT suggests that, through exposure to multiple exemplars of this type of pattern in the

presence of these contextual cues, eventually the relational response becomes abstracted such that it can be applied under conditions in which there is no obvious formal comparative relation; for example, after being told that "Mr. A is bigger than Mr. B," a child will be able to derive that "Mr. B is smaller than Mr. A."

NARR and AARR are both forms of relational responding in that both involve the subject's responding to one stimulus in terms of another stimulus and both are generalizable. Furthermore, in both cases there is a variety of different patterns of relating that may be involved, such as sameness, difference, comparison, and so on. However, the source of ultimate control over the relational performance is crucially different in these two cases. In the case of NARR, the relational response pattern is defined by the nonarbitrary or formal relations between the relata, whereas in the case of AARR, the pattern is under the control of a contextual cue that specifies the relation such that the relational response can be brought to bear on any relata regardless of their nonarbitrary properties.

The MTS protocol can also be used to demonstrate AARR. In fact, as previously stated, RFT sees the well-researched phenomenon of stimulus equivalence (e.g., Sidman, 1971), which is typically trained and tested using MTS (see Sidman & Tailby, 1982, for a discussion of the distinctions among conditional discriminative responding, MTS, and equivalence), as an example of arbitrarily applicable sameness relational responding. One of the features of the typical stimulus equivalence paradigm that supports the contention that this is indeed arbitrarily applicable sameness relational responding is that, in the typical stimulus equivalence protocol, the baseline conditional discrimination training employs stimuli that do not resemble each other along any consistent formal dimension; thus, the subsequent symmetrical and transitive relational patterns between these stimuli should not be based on nonarbitrary sameness.

Conditional discrimination procedures in which the experimenter-designated correct sample–comparison combinations are not based on nonarbitrary relations is sometimes referred to as *arbitrary* MTS training. From an operational point of view, arbitrary MTS is a conditional discrimination training procedure in which the contingencies are such that the correct comparisons can (and should) be picked on a basis other than (a) any nonarbitrary relation with the experimenter-designated samples and (b) any prior training involving the particular stimuli used during the present training procedure or stimuli in any way formally similar to them. From a process perspective, arbitrary MTS is conditional discriminative responding in which the correct comparisons are not being picked on any basis other than the contingencies in operation in the operational definition.

An example of an arbitrary conditional discrimination operation might be reinforcing the choice of a green circle in the presence of a horizontal line and the choice of a red circle in the presence of a vertical line. In this case, the correct response is based on an arbitrary decision by the experimenter, as opposed to nonarbitrary formal relations between the stimuli involved. Because the task is not based on any consistent nonarbitrary sample–comparison relation, the performance cannot be generalized based on nonarbitrary relations. This is critical for the unambiguous demonstration of patterns of AARR including stimulus equivalence, because the control must be based on aspects of context that, as previously suggested, specify the relation such that the relational response can be brought to bear on any relata regardless of their nonarbitrary properties.

Despite attempts to ensure that nonarbitrary relations between stimuli do not come to influence responding in arbitrary MTS procedures, participants' behavior can often come under this form of control, especially in the initial stages of such procedures. For example, equivalence training often involves the use of three-letter nonsense syllables as stimuli and, despite the best efforts of the experimenter to ensure the absence of consistent nonarbitrary relations between these stimuli, participants often identify consistencies and may respond on the basis of these at least for an initial period of time in training. For example, if *mez* was arbitrarily chosen by the experimenter as a training match for *tik*, then a participant might discriminate nonarbitrary similarity between the two based on the presence of a line at a 45-degree angle in the final letter, and their responding might subsequently come under the influence of similar features in other stimuli. If the choice of stimuli is reasonably well organized, however, patterns of nonarbitrary relations will be less likely to be present in a consistent manner and will not control responding over the longer term.

Although nonarbitrary relations can interfere with arbitrary relational training, there is also the possibility of arbitrary relations affecting NARR. Given a verbal human as an experimental participant, patterns of AARR cannot be precluded in the presence of an ostensibly nonarbitrary relational task. For example, imagine a verbal participant exposed to a conditional discrimination task in which he or she must pick a comparison that is more physically similar to the sample than the other comparison. Even though responding may formally resemble NARR (in accordance with sameness), it is possible that subtle aspects of the context (e.g., the MTS format) may also influence the response by bringing AARR (also in accordance with sameness) to bear on task stimuli. Nevertheless, in such protocols, the conservative assumption is that AARR is not present because NARR can already explain the performance.

Explaining the Inconsistency

At this point, we have defined and discussed examples of relational responding, which we suggested was necessary to properly explore and explain the issue of the apparent inconsistency identified at the beginning of this paper. So how might we resolve this apparent inconsistency in which functionally similar procedures are being given apparently contradictory labels: nonarbitrary relational training and arbitrary MTS?

First, from an RFT perspective, both procedures are being used to establish contextual control in abstract stimuli using a protocol that involves NARR. In both procedures, the participants are being trained to relate stimuli (i.e., the comparison stimuli) based on nonarbitrary comparative relations between those stimuli in the presence of particular abstract stimuli (i.e., the sample stimuli) that should subsequently come to control generalized arbitrarily applicable comparative relational responding. However, whereas Berens and Hayes (2007) refer to their procedure as *nonarbitrary training*, Dougher et al. (2007) refer to theirs as *arbitrary MTS*. In fact, both groups are correct, but they are labeling the task based on different aspects of the protocol. Berens et al. are describing the type of relational responding involved, which, as explained, is NARR. Dougher et al., however, are labeling the task according to structural features of the protocol as traditionally defined as an MTS-based conditional discrimination. The arbitrary aspect of the task to which they refer is the fact that, as previously outlined, there is no consistent physical relation between the sample (the contextual cue) and the comparisons (the stimuli that, in this case, are being nonarbi-

trarily related to each other based on nonarbitrary size).

This resolution clears up the apparent inconsistency identified initially, but our explication of relational responding in the context of the conditional discrimination procedure allows us to go further. The use of the term *arbitrary MTS* by Dougher et al. (2007) seems to suggest an arbitrary relation between the sample and comparisons. Indeed, as we will see, this term does refer to an arbitrary relation and can in fact be linked with AARR. However, as we will explain, in this case it is not the behavior of the participant that is at issue but rather the behavior of the scientist.

For more than one reason, the arbitrary nature of the relation between the sample and comparisons in the case of the Dougher et al. (2007) protocol cannot, from a purely theoretical (i.e., RFT) perspective, be assumed to be an arbitrary *relation* for those participants deemed to be responding in accordance with their training. This is true, first, because in the protocol employed by Dougher et al., the stimulus at the top of the screen was intended to function as a contextual cue controlling the relational response emitted by the participant and not as a sample stimulus entering a relation with another comparison stimulus. Hence, this was not an arbitrary relation *for the participant* because Dougher et al. were not using the conditional discrimination procedure to target relational responding between sample and comparison on the part of the participant. Instead, they were employing the procedure to generate nonarbitrary comparative relational responding between the comparisons, under the control of abstract shapes that were thus established as contextual cues for generalized comparative relational responding. In a subsequent part of the study, these cues were used to establish an abstract comparative relational network between arbitrary stimuli and to demonstrate transformation of physiological functions via those relations.

However, we argue that even if a formally similar conditional discrimination procedure was being used in the conventional way, and the scientist intended the participant to learn a conventional conditional discriminative relation, it is still the case, again from a strictly theoretical perspective, that a participant might not be doing arbitrary relating of the sample and comparison. This is true for a fundamental reason that pertains to the nature of the responding targeted by any conventional arbitrary MTS conditional discrimination. We previously presented the definition of arbitrary MTS as a conditional discrimination training procedure in which the contingencies are such that the correct comparisons can (and should) be picked on a basis other than (a) any physical relation with the experimenter-designated correct samples and (b) any prior training involving the particular stimuli used during the present training procedure or stimuli in any way physically similar to them. As also explained, the typical purpose of this procedure is to ensure that responding cannot generalize on the basis of nonarbitrary relations between sample and comparisons.

In fact, in a traditional arbitrary conditional discrimination procedure, a participant is also not being trained to respond in accordance with an arbitrary relation between sample and comparison, because being trained to respond in accordance with one or a limited number of conditional discrimination performances is not generalizable and thus does not meet a core criterion of relational responding as provided in the current paper. Hence, the participant is coming under conditional discriminative control but, according to our definition, is not responding relationally.

Hence, again from a purely theoretical perspective, for the participant in an arbitrary conditional discrimination procedure, there is no arbi-

trary relation between sample and comparison being learned. Despite this, the nomenclature is well established and widely employed (e.g., Pilgrim, Jackson, & Galizio, 2000; Saunders & Williams, 1998). Nevertheless, as we suggested previously, there is still an arbitrary relation at issue, because there is still AARR being performed with respect to the sample and comparison. However, this AARR is not a feature of the behavior of the participant but of the scientist.

From the perspective of radical behaviorism, the scientist is also a behaving organism, and a behavior analysis of his or her behavior is thus also possible (see, e.g., Barnes & Roche, 1997; McIlvane & Dube, 2003; Skinner, 1974; for more indepth discussion of this issue). For the scientist, stimuli in the protocol are being related in an arbitrarily applicable relational (i.e., verbal) response that is visible, for example, when he or she describes the experimental setup to colleagues in formal or informal interactions or through writing up the scientific report of the study. However, it is of course imperative that the relating of the stimuli by the scientist not be confused with the relating of the stimuli by the participant. Nevertheless, nomenclature, such as has been traditionally used to describe the MTS protocol, might be argued to allow such confusion under certain circumstances, especially in those cases in which either NARR or AARR on the part of the participant is the focus of the scientist.

Furthermore, this is not the only example in which a protocol has arguably been defined based on the behavior of the scientist rather than that of the participant. Another example is the use of the term *identity matching* as a description of conditional discriminative responding in which the sample and comparison happen to be physically similar but in which only a very limited number of such responses is tested (see, e.g., Martin, Thorsteinsson, Yu, Martin, & Vause, 2008). Identity matching, as a form of nonarbitrary relational responding, can only be affirmed by testing for generalization using multiple exemplars. Hence, it can be argued that use of the term *identity matching* in the absence of such testing is more relevant to the behavior of the scientist, who is recognizing the formal similarity of the relata in his or her use of that description, than to that of the participant.

Labeling a protocol based on the behavior of the scientist rather than that of the participant is one way in which a procedural label might mislead. Another, which again is relevant to the two studies under discussion, is when the label describes just one aspect of the procedure but not what might be argued to be the most important aspect. With regard to the current example, even though we have focused in particular on *arbitrary* versus *nonarbitrary* in describing the type of protocol used by the two groups, a label more accurate than that in either case might have described the protocol in question as one designed to establish a contextual cue for comparative relational responding (see, e.g., Lipkens & Hayes, 2009) as opposed to tacting the presence of either AARR or NARR during training. This latter is another example of labeling in accordance with an established tradition of nomenclature, however (see, e.g., Roche & Dymond, 2008; Whelan & Barnes-Holmes, 2004), and although this type of label might be argued to be less misleading than some cases discussed above, focusing on the target behavior might improve communication.

Conclusion

In summary, the present paper identified an apparent inconsistency between the descriptions employed in two separate studies of a functionally

similar conditional discrimination procedure used to train relational responding. In investigating this apparent inconsistency, we explored the use of the conditional discrimination procedure as a methodology for training and testing relational responding, both NARR and AARR. On this basis, the paper explained the apparent inconsistency as a difference in the aspect of the task being described. At a more general theoretical level, it was argued that labeling in studies on relational responding should focus on the functional target of the protocol with respect to the behavior of the experimental subject rather than on some alternative feature of the protocol.

Perhaps the final message is that, as scientists, we should be as careful as possible in our use of descriptive labels, especially when using such labels in the context of a relatively novel or perhaps complex topic of empirical investigation such as generalized (nonarbitrary, arbitrary, and arbitrarily applicable) relational responding. Focusing our labeling of procedures on the functional target of an established procedure rather than on some alternative feature may be a maximally effective way of establishing influence over the future behavior of other behavioral scientists and ourselves.

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